RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: 1st

Wisconsin Department of Transportation
DT1241 2009

Research, Development and Technology Transfer	
Program: (Choose One) ☐ **Policy Research** ☐ **Pooled Fund TPF #** ☒ **Wisconsin Highway Research Program** ☐ **Other**	
Project Title: Effective Depth of Soil Compaction in Relation to Applied Compactive Energy	
Administrative Contact/Phone #: Peg Lafky/608-266-3663	**WisDOT Project ID(s):** 0092-08-11
WisDOT Technical Contact/Phone #: Bob Arndorfer/608-246-7940	**Other Project ID:**
Project Investigator/Phone # (agency & contact): Dante Fratta/608-265-5644 & Haifang Wen - University of Wisconsin-Madison	**Approved Starting Date:** 10/10/2007
WisDOT Comments:	**Original End Date:** 4/10/2009 **Current End Date:** 10/10/2009
Sponsor: Wisconsin Department of Transportation	**Number of Extensions:** 1

Schedule Status:

☐ On schedule ☐ Ahead of schedule
☒ On revised schedule ☐ Behind schedule (Please explain below)

Total Project Budget	Expenditures Current Quarter	Total Expenditures	% Funds Expended	% Work Completed
$54,914.00	$4,567.76	$52,073.53	94.8%	85%

Project Description:

The determination of the appropriate lift thicknesses used in embankment construction operations has important economic and engineering implications for the design and construction of roads, levees and dams. For example, small lift thicknesses may cause excessive construction costs while large lift thicknesses may reduce the compaction effectiveness and compromise the integrity of the embankment. This research proposal uses experimental results and numerical analyses to evaluate the effective depth of compaction. These results and analyses will provide engineering understanding of the problem and justify recommendations about maximum lift thickness to be used in WisDOT embankment construction projects.

This research program collects field data and develops analyses needed to determine optimum lift thickness for WisDOT embankment construction projects. The results will help to establish relationships between the applied compaction energy and the level of compaction achieved at increasing depths for a number of different soils. The data, analyses, and correlations will help WisDOT officials in proposing possible revisions to current constructions specifications including the need to change the established 8-in lift thickness in the construction of compacted embankments. The successful completion of this research will also help WisDOT officials in improving construction operations by creating more stable and economical subgrade structures.

Progress This Quarter: (Includes project committee meetings, work plan status, contract status, significant progress, etc.)

During this quarter, the research team interpreted and correlated field data to evaluate the changes of soil characteristics due to field soil compaction. The research team also began numerical modeling and analysis to evaluate the compactive energy propagation in embankment construction operations. Draft the final report and completed two drafts of journal publications.

Field data correlation: To evaluate the response of the soil during compaction operations, several devices were implemented in the field, including soil stiffness gauge (SSG), time domain reflectometry (TDR), nuclear density gauge (NDG), dynamic cone penetrometer (DCP), and seismic analysis using MEMS (miniature electro-mechanical system) accelerometers. To examine the reliability of collected data, the field data correlations were evaluated.

Figure 1 shows the modulus differences between SSG and P-wave propagation by MEMS. Figure 2 presents correlations between stiffness (obtained using SSG) and the shear strength (obtained using DCP). The relationship between volumetric water content (TDR) and DCP index is presented in Figure 3.

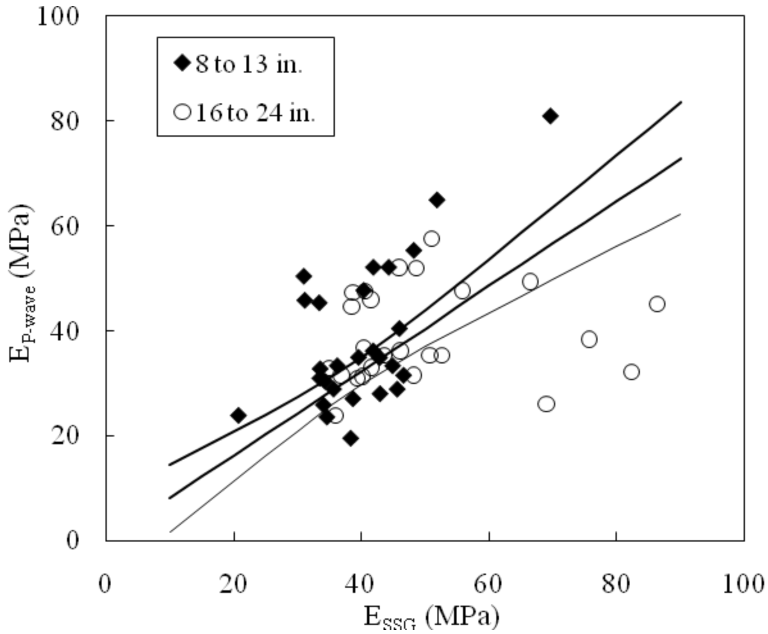

Figure 1. Elastic modulus of SSG and P-wave propagation.

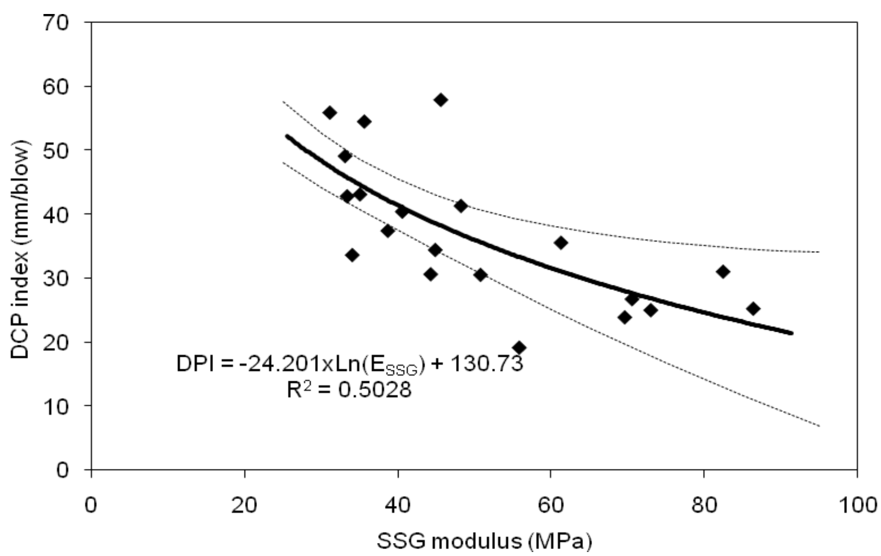

Figure 2. Correlatiaon of SSG and DCP.

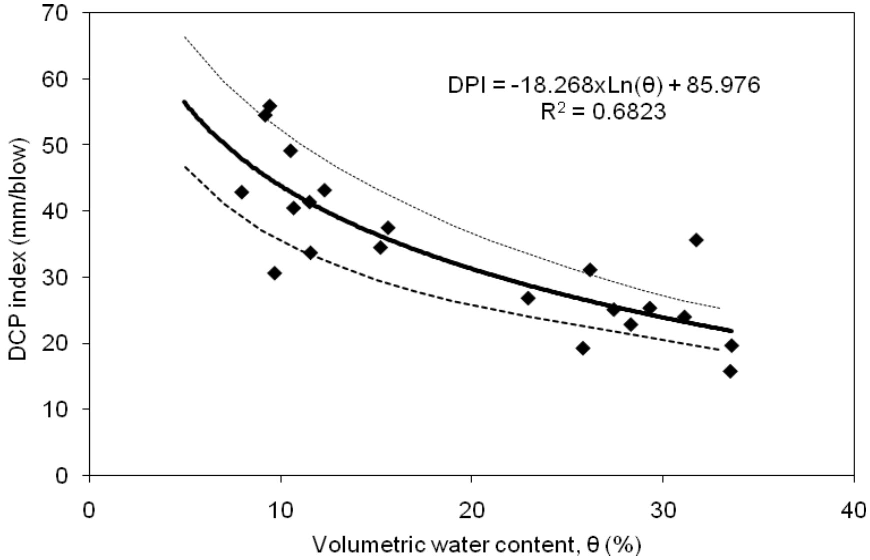

Figure 3. Correlation of TDR and DCP.

Numerical modeling: To evaluate moving load effect on the rotation of elements, the principal stress rotations at the soil elements have been investigated (Figure 4). And, the different contact areas of compacting wheel were simulated to assess the influencing depth of compacting load (Figure 5).

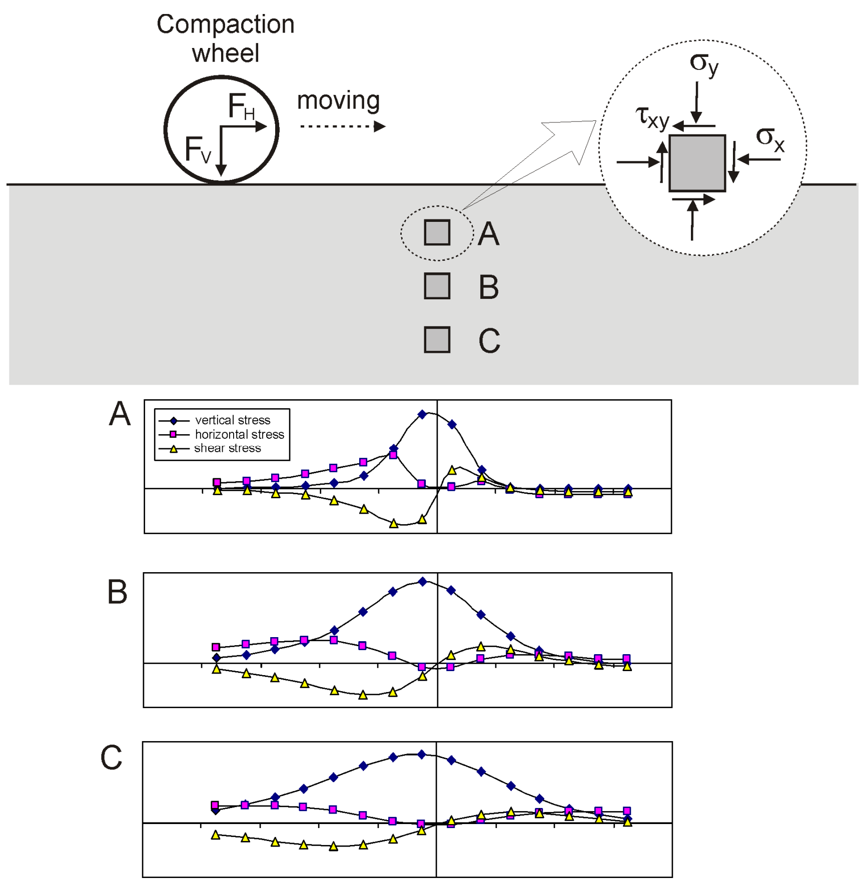

Figure 4. The principal stress rotation during wheel load moving.

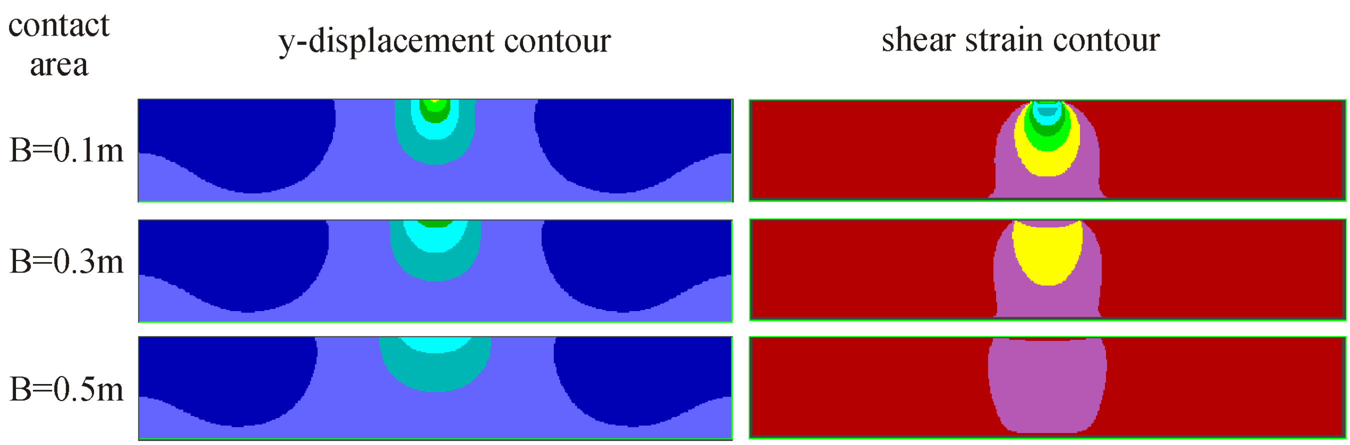

Figure 5. The vertical displacement and shear strain contours for evaluating the influence depth.

Anticipated Work Next Quarter:

During the seventh quarter, the research team will complete the interpretation of the field measurement results and will correlated these results to the numerical model analysis to estimate the compaction efficiency depth for determining allowable lift thickness.

Circumstances Affecting Progress and/or Budget:

None

Gantt Chart:

Phase Number	24 months)							
	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6	Quarter 7	Quarter 8
Phase I								
Phase II								
Phase III								
Phase IV								
Phase V								